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OPERATION & MAINTENANCE

HANDBOOK

MODEL P901

PLUG-IN OUTPUT UNIT

DATAPULSE®

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PLUG-IN OUTPUT UNIT

DATAPULSE
DIVISION OF DATAPULSE INCORPORATED
10150 W. JEFFERSON BLVD., CULVER CITY, CALIF. 90230

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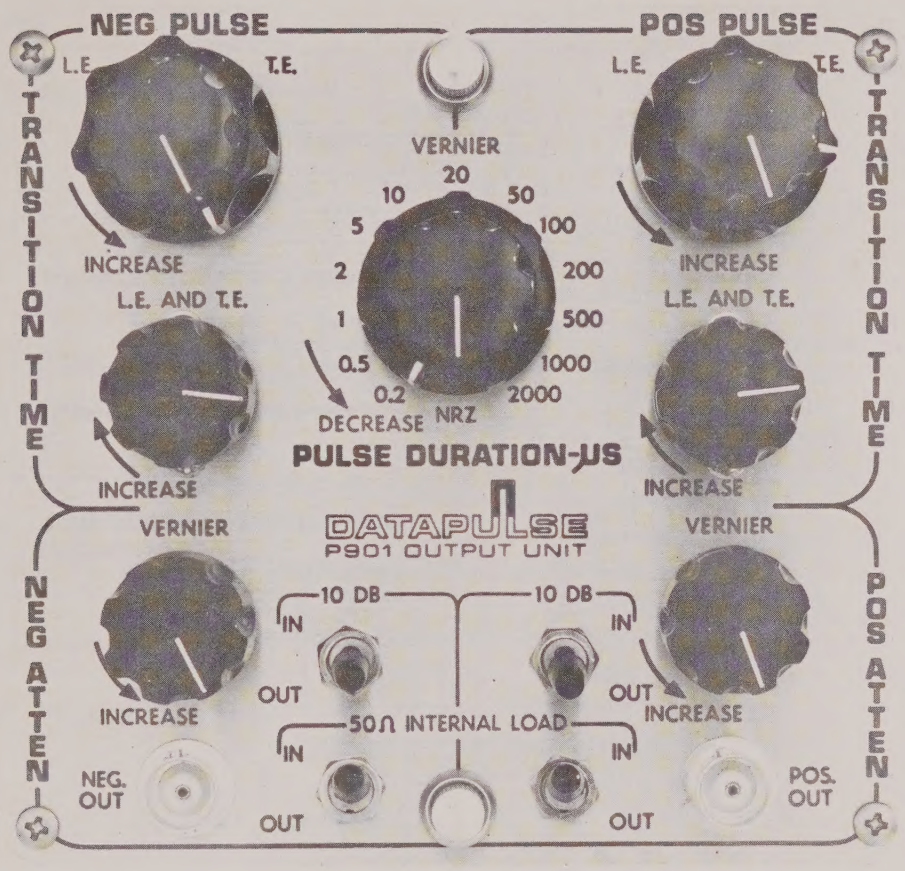

MODEL P901 PLUG-IN OUTPUT UNIT

The P901 Plug-in Output Unit is designed for use with DATAPULSE Model 103M, 200M, and 202M test instruments. The P901 features simultaneous positive and negative output pulses, with independently variable leading and trailing edge transition times; high power, current output pulses; and pulse width variation control from less than 50 nanosec. to 2,000 microsec.

This manual provides detailed instructions for the use and maintenance of your Model P901. A thorough understanding of its contents will contribute to full utilization and longer life of this unit.

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SECTION I

SPECIFICATIONS

1.1 INPUT TRIGGER REQUIRED

Neg. 2 volt pulse from 100 ohm source, 10 nanosec. rise time, 20 nanosec. wide, 5 mc maximum repetition rate.

1.2 OUTPUT PULSES

Pos. and neg. provided simultaneously, DC coupled with base line effectively at ground (with 50 ohm load or less). Outputs may not be connected to loads at other than ground level or to other signal sources without observing special precautions. The pos. and/or neg. outputs of two units may be mixed (through Type 2301 Mixer Unit, available as an accessory), reducing output amplitude approximately 50%.

1.2.1 Pulse Delay

Leading edge of pulse outputs and transition time of NRZ outputs is delayed from the input trigger approximately 60 nanosec.

1.2.2 Pulse Duration

Both outputs continuously variable, simultaneously, from less than 50 nanosec. to 2,000 μsec., covered in 13 steps (1, 2, 5 series) plus uncalibrated vernier. Also provides non-return-to-zero output when used with 200 Series instruments. Step control accuracy is approximately 10%. Circuit recovery time allows operation up to at least 50% duty cycle.

1.2.3 Amplitude

Outputs are current sources, variable in peak amplitude from 100 to 300 MA (15V Maximum) when driving load impedances of 50 ohms or less (higher impedance loads may be driven with clean output only within the limitations indicated). Separate controls are provided for each output.

1.2.4 Attenuation

Outputs may be separately attenuated 10 db by front panel switch setting.

1.2.5 Internal Load

An internal 50 ohm load may be switched in for each output to provide proper source impedance to coaxial cables.

1.2.6 Transition Times

The leading edge and trailing edge transitions are essentially linear and may be adjusted simultaneously, or separately with only minor interaction. Any combination of leading and trailing edge times within the ranges specified below may be achieved, within the following limitations: Maximum leading to trailing edge ratio approximately 10:1, maximum trailing to leading edge ratio approximately 3:1, both ratios approaching unity at minimum transition times. Separate controls are provided for the Pos. and Neg. output. Specified ranges may be extended by the addition of capacitors to internal circuitry.

Leading Edge Transition Time:
Continuously variable from less than 20 to more than 300 nanosec.

Trailing Edge Transition Time:
Continuously variable from less than 20 to more than 200 nanosec.

1.3 POWER REQUIRED

+ 18v at 15 ma	- 10v at 35 ma
+ 23v at 350 ma	- 5v at 20 ma
+ 26v at 60 ma	- 18v at 15 ma
+ 30v at 55 ma	- 23v at 300 ma
+ 35v at 7.5 ma	- 26v at 60 ma
+ 10v at 5 ma	- 30v at 55 ma
	- 35v at 7.5 ma

All power required is available from standard DATAPULSE plug-in type instruments.

1.4 CONSTRUCTION

Brushed aluminum front panel with etched black and red markings. Plugs into space provided in standard DATAPULSE instruments, mating with 24 contact Blue Ribbon female connector. Front panel output connectors are BNC type. Size is 4 3/8" H x 4 3/4" W x 6 9/16" D.

1.5 ACCESSORIES

Furnished with one operation and maintenance manual section for insertion in basic instrument manual. For other accessories available see Technical Bulletin 2000.

SECTION II

OPERATING INSTRUCTIONS

2.1 DESCRIPTION OF CONTROLS AND CONNECTORS

2.1.1 TRANSITION TIME

2.1.1.1 L.E.: Red concentric knob controls the leading edge transition time of the output pulse*.

2.1.1.2 T.E.: Black concentric knob controls the trailing edge transition time of the output pulse*.

2.1.1.3 L.E. and T.E.: Simultaneously controls the leading and trailing edge transition times of the output pulse.

The righthand transition time controls affect the positive output pulse; the lefthand controls affect the negative output pulse.

2.1.2 NEG. ATTEN. - (Negative Output Pulse Attenuator)

2.1.2.1 Vernier: Controls the attenuation of the negative output pulse power from zero through 10 db when the output is loaded with 50 ohms.

2.1.2.2 10 db: Provides ten decibels attenuation of negative output pulse power when the output is loaded with 50 ohms.

2.1.2.3 50 Ohms Internal Load: Provides a 50-ohm resistive load between the negative output pulse and ground.

2.1.3 POS. ATTEN. - (Positive Output Pulse Attenuator)

2.1.3.1 Vernier: Controls the attenuation of the positive output pulse power from zero through 10 db when the output is loaded with 50 ohms.

2.1.3.2 10 db: Provides ten decibels attenuation of the positive output pulse.

2.1.3.3 50 Ohms Internal Load: Provides a 50-ohm resistive load between the positive output pulse and ground.

2.1.4 Duration - μs, Vernier

Simultaneously controls the positive and negative output pulse widths. Step calibration is made at the factory with all front panel controls turned fully clockwise.

2.2 PLACING IN OPERATION

Plug the P901 in and turn the POWER switch ON. Switch the 50 Ω internal load switches IN.

Make sure the spacing of the input triggers is not less than approximately twice the pulse width as set on the DURATION switch.

Observe the output pulse and vary the controls, observing their operation as explained in Paragraph 2.1 of this manual.

If the P901 seems to be operating improperly, refer to Troubleshooting Procedure in this manual.

2.3 OPERATING CONSIDERATIONS AND SPECIAL APPLICATIONS

2.3.1 The output amplifiers in the P901 are current generators and must deliver their current into a finite load impedance.

The maximum load impedance is dictated by the maximum output voltage of the P901 (approximately 15 volts).

Accordingly, there must be 50 ohms or less between the output and ground when delivering maximum (300 ma) output current.

---

*See Section I for the type of pulse required.

SECTION III

THEORY OF OPERATION

(Refer to Block Diagram--Dwg. #41000-002)

Consider the P901 as three basic circuits:

(1) A Pulse Width Gate Generator

(2) A Positive Pulse Amplifier

(3) A Negative Pulse Amplifier

The pulse width gate generator consists of a monostable multivibrator with emitter follower cross-coupled on one side to improve output waveshape. The multivibrator output consists of two gates; a negative and a positive. These gates are used to drive their respective pulse amplifiers. The two pulse amplifiers operate identically in theory and differ only in that the polarized components are reversed. Therefore, only the operation of the negative amplifier will be explained.

Two stages of DC amplification change the DC level of the negative gate to drive the charge and discharge current transistors Q1 and Q2.

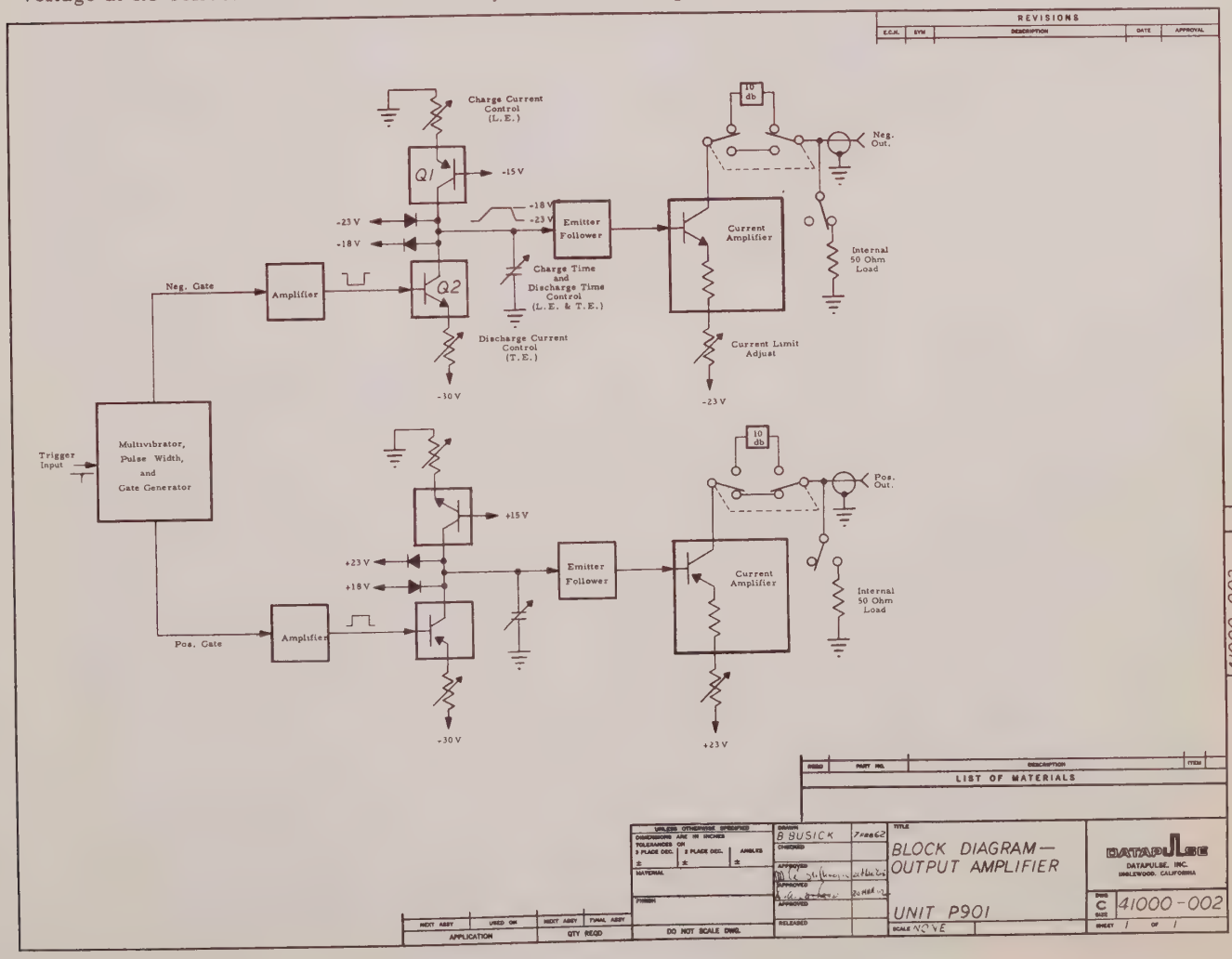
In a quiescent condition, Q2 is conducting and the voltage at its collector is held at -23 volts by the diode clamp. When the input gate goes negative, Q2 is turned off and the voltage at its collector rises at a rate determined by the current through Q1 and the capacity of C_1.

$$\frac{dE}{dt} = \frac{I_{(Q1)}}{C_{(1)}}$$

The voltage is clamped at -18 volts until the pulse width gate allows Q2 to conduct. The voltage now returns to -23 volts at a rate determined by the current through Q2 and the capacity of C_1.

It should now be evident that the charge current control, the discharge current control and C_1 correspond to the front panel NEG. PULSE - TRANSITION TIME controls, L.E., T.E., and L.E. and T.E. respectively.

The waveform at the collector of Q2 is amplified by an emitter follower, which drives the output current amplifier.



SECTION IV

MAINTENANCE INSTRUCTIONS

4.1 PREVENTIVE MAINTENANCE

4.1.1 Cooling

The P901 utilizes forced-air cooling to maintain tolerable temperatures within the unit at specified maximum output power. It is important that the covers supplied with the instruments to which the P901 is connected be kept in place during operation.

4.1.2 Recalibration

The P901 contains very stable circuitry and the unit will provide many hours of trouble-free operation. To insure continued reliability, the power supply and pulse width multivibrator should be checked for calibration after each 500 hours of operation, or at least every six months if the plug-in is used intermittently.

4.1.3 Visual Inspection

Conduct visual inspections at regular intervals, preferably every few months. Check for possible circuit defects including loose or broken connections; scorched printed circuit boards, wires, or resistors; and loose nuts and bolts.

4.1.4 Component Replacement and Soldering Connections

When replacing transistors, diodes, or other heat-sensitive devices, a heat sink should be used between the device and the soldering iron tip. A pair of long-nosed pliers may be used in most cases.

Special care must be taken, when soldering printed circuit wiring, to avoid overheating and subsequent separation of the printed circuit from its epoxy material.

4.2 TROUBLESHOOTING PROCEDURE

The first points to check after most malfunctions are the power supply voltages.

The voltages used for the P901, except for the ± 18 volt supplies, should be within ± 5% of their specified value. Note, that most of the voltages must be adjusted in a certain sequence due to the referencing.

The sequence which must be used is as follows:

(1) + 10v
(2) - 10v
(3) - 5v
(4) - 23
(5) + 23
(6) any of the others

The following table should prove useful in isolating malfunctions within the unit. Once the area of trouble is isolated, the waveform diagrams and schematic diagrams in this manual may be used to locate the defective components.

TABLE 4-1

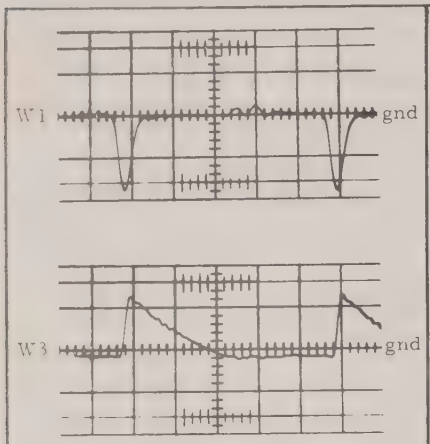
TROUBLESHOOTING CHECKS

MALFUNCTION	POSSIBLE CAUSE
NO OUTPUT PULSE * W11 (OR W21)	
Check for	1. Check for absence of pulse load 2. Output Current Amplifiers Q12, Q13, and Q14, (or Q20, Q21 and Q22).
NO DRIVING PULSE FOR OUTPUT STAGE - * W10 (OR W20)	
Check for	Pulse Shaping Circuits and Emitter Follower Q9, Q10, Q11 (or Q17, Q18 and Q19).
NO GATE INPUTS - * W8 (OR W18)	
Check for	Gate Amplifiers Q7 and Q8 (or Q15 and Q16).
NO NEGATIVE OR POSITIVE GATES FROM MULTIVIBRATOR	
Check for	1. Check for absence of input trigger 2. Multivibrator inoperative: Q1, Q2, Q3, Q4, Q5, Q6. Check waveforms W1 through W5*.

* See Table 4-2, Characteristic Waveforms

TABLE 4-2. CHARACTERISTIC WAVEFORMS

The waveforms shown here should prove useful during troubleshooting. These photographs were taken with a Tektronix Type 580 Oscilloscope with a Type K Plug-in. Waveform numbers (W1, W2, W3 etc.) shown at the left of each waveform correspond to the numbers appearing on the schematic, drawing J40000-011.

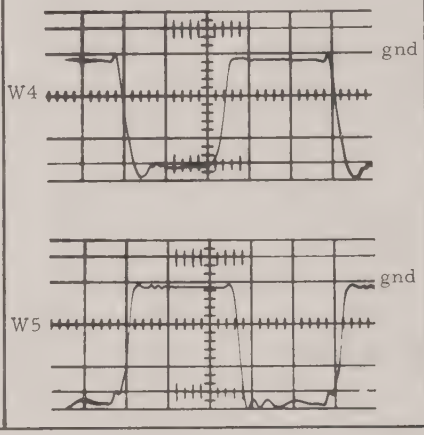


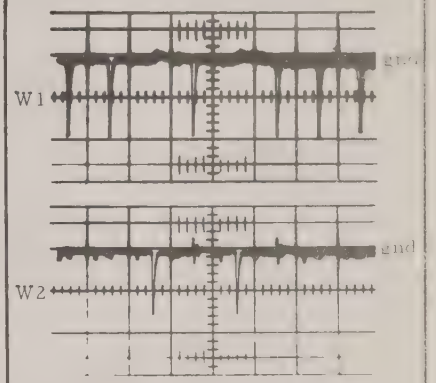
0.1 μs/cm 2v/cm
Trigger Rate: 2 mc/sec.
Pulse Duration: 0.2 μsec.

W1: Set Trigger Input
W2: Base Lead of Q3

0.1 μs/cm 2v/cm
Trigger Rate: 2 mc/sec.
Pulse Duration: 0.2 μsec.

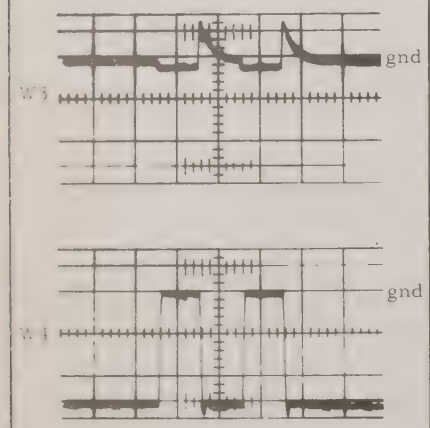
W4: Collector Lead of Q3
W5: Collector Lead of Q6





0.1 μs/cm 2v/cm
Trigger Rate: 1 mc/sec.
Pulse Duration: Set at NRZ

W1: Set Trigger Input
W2: Reset Trigger Input
(only available with 200 series word generators)
(Program 11010111)

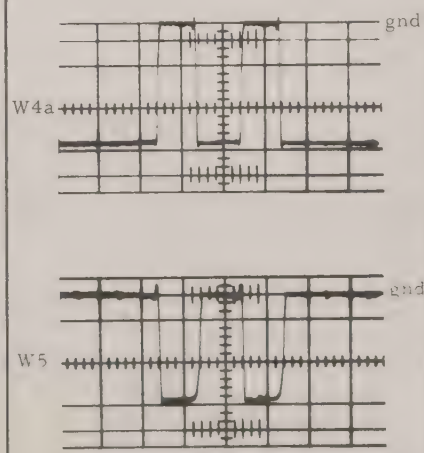


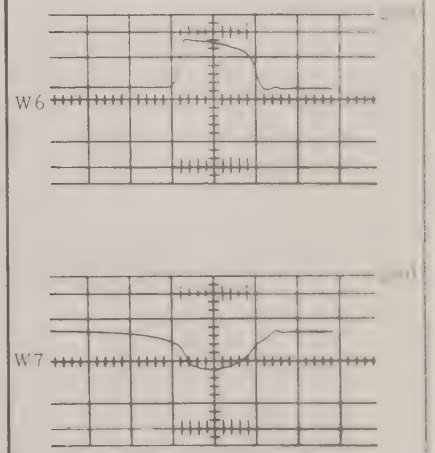
0.1 μs/cm 2v/cm
Trigger Rate: 1 mc/sec.
Pulse Duration: Set at NRZ

W3: Base Lead of Q3
W4: Collector Lead of Q3
(Program 11010111)

0.1 μs/cm 2v/cm
Trigger Rate: 1 mc/sec
Pulse Duration: Set at NRZ

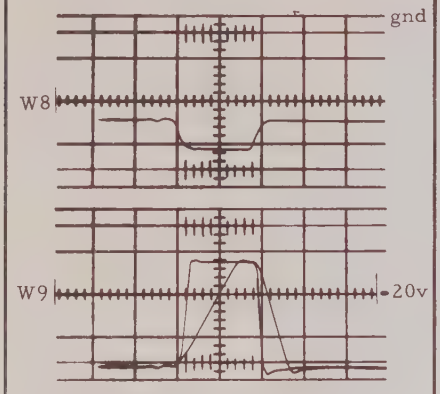
W4a: Emitter Lead of Q5
W5: Collector Lead of Q6





0.1 μs/cm 10v/cm
Pulse Duration: 0.2 μsec.
W6: Collector Lead of Q7
W7: Collector Lead of Q8

TABLE 4-2. CHARACTERISTIC WAVEFORMS -- CONTINUED

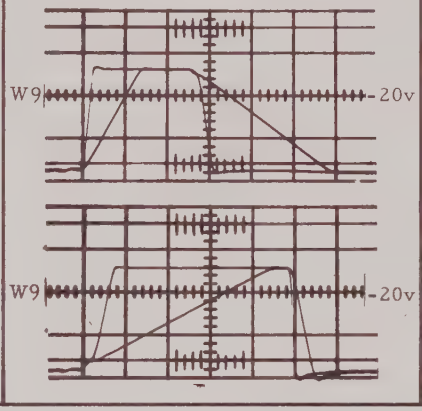


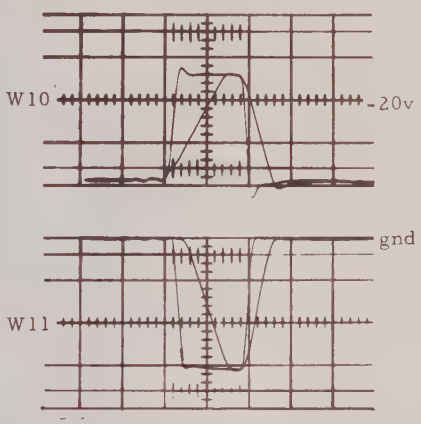
0.1 μs/cm 2v/cm
Upper: Pulse Duration: 0.3 μs, "L.E." cw, "T.E." ccw, "L.E. & T.E." first cw then ccw.
Lower: "L.E" ccw, "T.E." cw, "L.E. & T.E." first cw, then ccw.

W9: Junction of CR104 & CR105

Upper: 0.1 μs/cm, 10v/cm
Lower: 0.1 μs/cm, 2v/cm
Pulse Width: 0.2 μs.
Lower: "L.E." clockwise (cw), "T.E." (cw), "L.E. & T.E." first cw, then ccw.

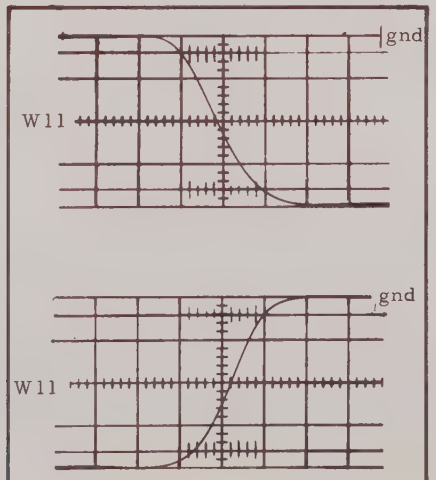
W8: Base Lead of Q9
W9: Junction of CR104 & CR105





0.1 μs/cm, Upper 2v/cm, Lower 5v/cm, Pulse Duration 0.2 μs, "L.E." cw, "T.E." cw, "L.E. & T.E." cw, then ccw.

W10: Emitter Lead of Q11
W11: Output Pulse



10 nanosec/cm 3.75v/cm
Output Pulse Waveforms showing Typical Rise and Fall Times (Neg. Pulse Output)

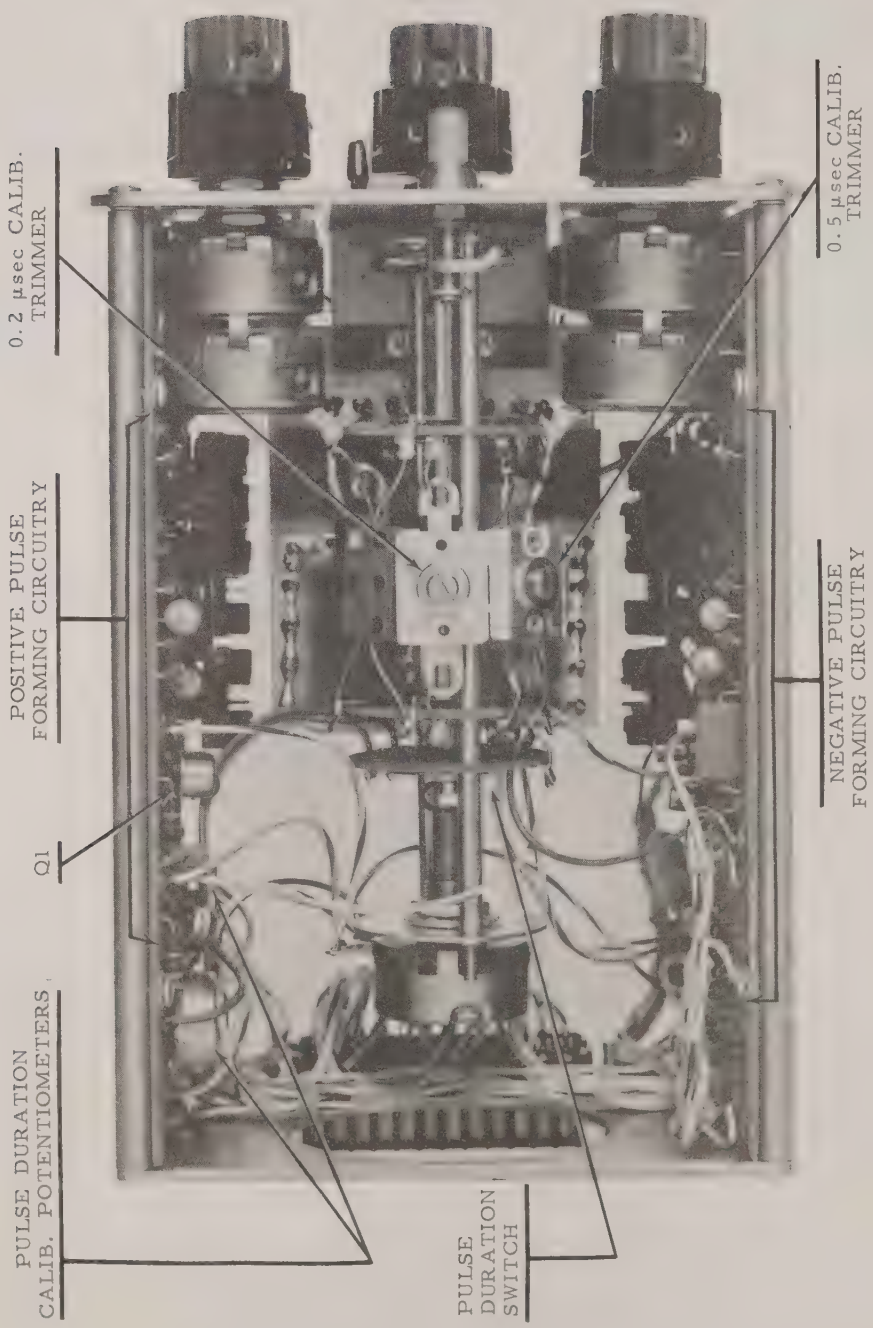
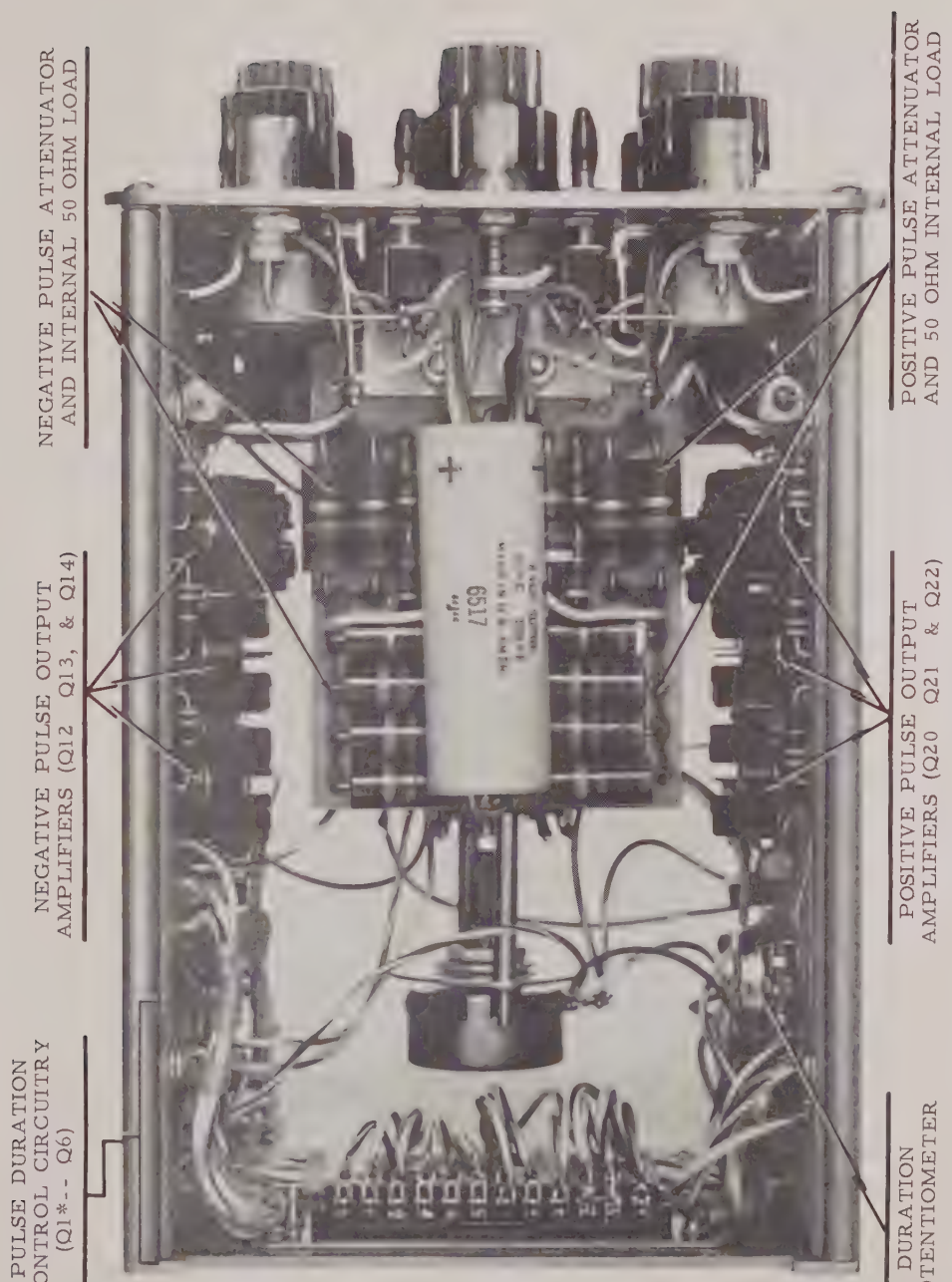


Figure 4-1. P901 (Top View)


PULSE DURATION CONTROL CIRCUITRY (Q1*-- Q6)
NEGATIVE PULSE OUTPUT AMPLIFIERS (Q12 Q13, & Q14)
NEGATIVE PULSE ATTENUATOR AND INTERNAL 50 OHM LOAD
PULSE DURATION CALIB. POTENTIOMETER
POSITIVE PULSE OUTPUT AMPLIFIERS (Q20 Q21 & Q22)
POSITIVE PULSE ATTENUATOR AND 50 OHM INTERNAL LOAD

*NOTE: Q1 is physically located on positive board.

Figure 4-2. P901 (Bottom View)

4.3 CALIBRATION PROCEDURE

4.3.1 Equipment Required

DC oscilloscope--Tektronix 541, Hewlett-Packard 150A or equivalent.

DC voltmeter--Any voltmeter with greater than 100 ohms per volt sensitivity, calibrated to ±5%.

4.3.2 Power Supply

The power supply (and adjustments thereto) for the P901 are located in the instrument with which the P901 is used. The + 23v supplies must be adjusted before the other voltages. All voltages should be within ±5% of the stated values except +18v and - 18v, these voltages are adjusted at the factory for limiting the output current in the 901.

4.3.3 Pulse Duration - μsec. (A Tektronix Type 541 oscilloscope or equivalent is needed for this calibration)

On the right side card of the P901 there are three screwdriver-adjust controls, labeled 50 μsec., 20 μsec., and 10 μsec.

Set the oscillator switch in the main instrument for 1 kc or less and the pulse delay for minimum delay.

Set the PULSE DURATION switch to 50μsec. and turn the vernier control fully clockwise and leave it there throughout the rest of the calibration.

Observe the positive or negative output pulse with all rise and fall time controls fully clockwise, for measurement.

Adjust the 50 μsec. calibration control for 50 μsec. pulse width.

Turn the PULSE DURATION switch to 20 μsec. and adjust the 20 μsec. calibration control for 20 μsec. pulse width.

Turn the PULSE DURATION switch to 10 μsec. and adjust the 10 μsec. calibration control for 10 μsec. pulse width.

No further calibration should now be necessary; however there are trimmer condensers on the PULSE DURATION switch to adjust the .5μsec. and 2 μsec. ranges if further calibration accuracy is desired on these ranges.

TABLE 4.3

PULSE DURATION CALIBRATION CHECK

CLOCK RATE (REPETITION RATE)	PULSE DURATION	VERNIER	SCOPE SWEEP SPEED (per cm)	CORRECT PULSE DURATION[1] (cm)	TOLERANCE (cm)
0.1MC/S	0.2μs	cw	.05μs(.1, magx2)	4.0	±0.4
0.1MC/S	0.2μs	ccw	.05μs(.1, magx2)	1.0 or less	--
0.1MC/S	0.5μs	cw	.1μs	5.0	±0.5
0.1MC/S	1μs	cw	.2μs	5.0	±0.5
0.1MC/S	2μs	cw	.5μs	4.0	±0.4
0.1MC/S	5μs	cw	1μs	5.0	±0.5
10KC/S	10μs	cw	2μs	5.0	±0.5
10KC/S	20μs	cw	5μs	4.0	±0.4
10KC/S	50μs	cw	10	5.0	±0.5
1KC/S	100μs	cw	20μs	5.0	±0.5
1KC/S	200μs	cw	50μs	4.0	±0.4
1KC/S	500μs	cw	.1ms	5.0	±0.5
1KC/S	500μs	ccw	.1ms	less than	1.8
0.1KC/S	1000μs	cw	.2ms	5.0	±0.5
0.1KC/S	2000μs		.5ms	4.0	±0.4

[1]Pulse duration is measured from the 50% amplitude point on the leading edge of the pulse to the 50% amplitude point on the trailing edge of the pulse.

4.4 SPECIFICATION VERIFICATION

Allow a 30 second warm up period before making tests. The following equipment, or its equivalent, is necessary.

a) A 5mc trigger source with ±10v, -5v, ±18v, ±23v, ±30v, & ±35v at the required currents (DATA PULSE Model 202M). DATA PULSE Model 200M is not capable of testing the 5mc operation and Model 103M will not check the NRZ operation, but either may be used with these limitations in mind).

b) Syncroscope (Tektronix Type 543 with Type L Single Trace Preamplifier).

IT IS ASSUMED THAT THE INSTRUMENT WITH WHICH THE P901 IS BEING USED FULLY MEETS THE REQUIRED SPECIFICATIONS AS TO POWER SUPPLY VOLTAGES AND TRIGGER INPUT WAVESHAPE.

4.4.1 Pulse Duration Plug the P-901 into one of the receptacles provided in its parent unit.

Turn power on.

Set CLOCK (REPETITION) RATE to 0.1 MC/S (VERNIER cw).

Throw all program switches (200 or 202) to the up position.

Set PULSE DELAY to 0.2 MICROSEC, (VERNIER ccw), do not actuate the ZERO DELAY switch on the 202.

Set PULSE DURATION to 0.2 μsec, VERNIER ccw.

Set the POS. PULSE & NEG. PULSE controls as follows.

CONTROL	SETTING
NEG. PULSE L.E.	fully cw
NEG. PULSE T.E.	fully cw
NEG. PULSE L.E. & T.E.	fully cw
NEG. ATTEN VERNIER	fully cw
NEG. ATTEN 10db	out
NEG. ATTEN 50ohm INTERNAL LOAD	in
POS. PULSE L.E.	fully cw
POS. PULSE T.E.	fully cw
POS. PULSE L.E. & T.E.	fully cw
POS. ATTEN VERNIER	fully cw
POS. ATTEN 10db	out
POS. ATTEN 50ohm INTERNAL LOAD	in

Set Scope Speed to .1 μsec/cm, Vertical sensitivity 5v/cm.

Sync scope from clock (reference) sync output.

View the Negative Pulse Output.

See Pulse Duration Settings - Table 4-3.

4.4.1.1 NRZ Operation: Program switches 1 and 3 to the down (zero) position (use the programming switches which correspond to the channel output being used).

Sync Scope on Bit One sync output.

Set PULSE DURATION to NRZ.

Set PULSE DELAY VERNIER fully ccw, (actuate the ZERO DELAY switch).

Set CLOCK RATE to 1 KC/S, VERNIER cw.

Set sweep speed to .2msec/cm.

Verify a negative pulse, 5 cm wide, (±10%) after a delay of 5cm (±10%).

Set CLOCK RATE to 5MC/S, VERNIER cw (2MC/S on the 200).

Set sweep speed to .1 μsec/cm.

Program switch number 3 to the up (one) position.

Verify a positive pulse which disappears when the number 1 switch is thrown to the up (one) position.

Verify the pulse width of 2cm (±10%). (5cm on the 200).

Program the number 1 switch to the up (one) position so that now all switches are in the same position.

4.4.1.2 Duty Cycle: Sync scope from clock or Reference Sync Output.

Set CLOCK (REPETITION) RATE to 2MC/S, VERNIER ccw.

Set sweep speed to .1 μsec/cm.

Set PULSE DURATION to 1 MICRO SEC, VERNIER ccw.

Line up the leading edge of the pulse with the far left side of the scope graticule.

Turn the PULSE DURATION vernier cw until the Pulse Width is 5.0cm.

Turn the CLOCK RATE (REPETITION RATE) Vernier cw until the leading edge of a second pulse lines up with the right hand side of the scope graticule. (50% duty cycle).

Verify that no perceptible change (less than 5%) occurred in the pulse width of the first pulse when the above adjustment was made.

4.4.2 Pulse Amplitude

Set CLOCK RATE to 0.1MC/S, VERNIER cw

Verify neg pulse amplitude of 3cm or more.

Throw the 10db switch associated with the NEG ATTEN to IN.

Verify neg. pulse amplitude of 1cm (3 to 1 reduction ±10%)

Throw the 10db switch to OUT and turn the NEG ATTEN Vernier fully ccw.

Verify a pulse amplitude of less than 0.9cm.

Turn the Vernier cw.

Observe the Pos Output Pulse.

Verify the pos. pulse amplitude of 3cm or more.

Throw the 10db switch associated with the POS ATTEN to IN.

Verify pos pulse amplitude of 1cm (3 to 1 Reduction ±10%).

Throw the 10db switch to OUT and turn the NEG ATTEN VERNIER fully ccw.

Verify a pulse amplitude of less than 0.9cm.

Turn the Vernier cw.

4.4.3 Leading & Trailing Edge Transition Times

Adjust scope Vertical Sensitivity so the pos pulse amplitude is 4.0cm.

Set scope sweep speed to 20nsec/cm. (.1μsec x5)

Verify leading and trailing edge transition times of less than 23 nsec., (10 to 90% points).

Observe the Neg. Output Pulse.

Set scope sweep speed to .1μsec/cm (MAG x1)

Adjust scope vertical sensitivity so the neg. pulse amplitude is 4.0 cm.

Set scope sweep speed to .1μsec/cm.

Verify leading and trailing edge transition times of less than 23 nsec (10% to 90% points).

Set scope sweep speed to .1μsec/cm (MAG X 1)

Turn the NEG PULSE L.E. AND T.E. control fully ccw.

Turn the NEG PULSE L.E. control (Red Knob) fully ccw.

Verify a Neg. Output pulse leading edge transition time of more than 0.3μsec. (10% to 90% points).

Turn the L.E. control back fully cw.

Turn the T.E. control fully ccw.

Verify a Trailing edge transition time of more than 0.2μsec (10 to 90% points).

Observe the Pos Output Pulse.

Adjust scope vertical sensitivity so the pulse amplitude is 4.0 cm.

Turn the POS PULSE L.E. AND T.E. control fully ccw.

Turn the POS PULSE L.E. control fully ccw.

Verify a Pos. Output Pulse leading edge transition time of more than 0.3 μsec (10% to 90% points).

Turn the L.E. control back fully cw.

Turn the T.E. control fully ccw.

Verify a trailing edge transition time of more than 0.2 μsec (10% to 90% points).

This concludes the specification verification check.

SECTION V

PARTS LIST

5.1 HOW TO USE THIS PARTS LIST

5.1.1 Reference Designations

Reference designations used throughout this listing correspond with reference designations given on component location photos and the following schematics:

Dwg. No. 40000-011

Resistors are designated as R1, R2, R3, etc. and are fixed value, composition, 10%, and 1/2w unless otherwise noted.

Capacitors are designated as C1, C2, C3, etc. and are fixed value, 10%, 500v dc unless otherwise noted.

Diodes are designated as CR1, CR2, CR3; switches as S1, S2, S3; inductors as L1, L2, and L3; transistors are Q1, Q2, Q3, etc.

5.1.2 Abbreviations

The following abbreviations are used:

CER:	Ceramic
DPC:	Deposited Carbon
ELECT:	Electrolytic
GMV:	Guaranteed Min. Value
MP:	Metalized Paper
M:	Mica
SM:	Silver Mica
TANT:	Tantalum
µf:	Microfarad
µH:	Microhenry
ms:	Millisecond
µsec:	Microsecond
ns:	Nanosecond
NPN:	Negative-Positive-Negative
PNP:	Positive-Negative-Positive
OF:	Oil Filled
PT:	Paper Tubular
VAR:	Variable
VTQ:	Vitamin Q
WW:	Wire Wound
DPDT:	Double Pole, Double Throw
SPDT:	Single Pole, Double Throw
Germ:	Germanium
PIV:	Peak Inverse Voltage

PARTS LIST

5.2 CIRCUIT BOARD ASSEMBLY RIGHT SIDE (POSITIVE)

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.
5.2.1	Resistors				
R3	1	1K, 0.2w, 20%, Var. Comp	20240-102	71450	
R4	2	330 Ω	10021-331	01121	EB3311
R5	2	5K, 0.2w, 20% Var. Comp.	20240-502	71450	
R6	2	2.2K	10021-222	01121	EB2221
R7		Same as R5			
R8	3	1K	10021-102	01121	EB1021
R9	2	470 Ω	10021-471	01121	EB4711
R10	2	100 Ω	10021-101	01121	EB1011
R12		Same as R4			
R151	2	390 Ω, 5%	10011-391	01121	EB3915
R152	1	47K	10021-473	01121	EB4731
R153		Same as R151			
R154		Same as R8			
R155	1	1.5K	10021-152	01121	EB1521
R156		Same as R6			
R157		Same as R9			
R158	1	6.8K	10021-682	01121	EB6821
R159	1	180 Ω	10021-181	01121	EB1811
R161	1	22 Ω	10021-220	01121	EB2201
R162		Same as R10			
R163		Same as R8			
R165	2	4.7K	10021-472	01121	EB4721
R166		Same as R165			
R167	1	220 Ω	10021-221	01121	EB2211
R168	1	47 Ω	10021-470	01121	EB4701
R169	1	470 Ω, 2w	10023-471	01121	HB4711
R170 thru R175	6	33 Ω, 5%	10011-330	01121	EB3305

PARTS LIST

5.2 CIRCUIT BOARD ASSEMBLY RIGHT SIDE (POSITIVE)

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.
5.2.2	Capacitors				
C150	1	250 µf, 15v, Elect.	11151-257	Siemens	B41283A
C151	1	100 pf, 5%, S.M.	11017-101	00853	
C152	6	1µf, 50v, Elect.	11152-105		
C153		Same as C152			
C155 thru C157		Same as C152			
C158	1	22 µf, 35v, Elect.	11512-226	56289	
C159		Same as C152			
5.2.3	Transistors				
Q1	1		22595-000	15933	59-0
Q15 and Q16	2		22635-004	15933	63-4
Q17	1		22605-001	15933	60-1
Q18 and Q19	2		22635-003	15933	63-3
Q20 thru Q22	3		22605-002	15933	60-2
5.2.4	Diodes				
CR151 thru CR155	5		22164-000	93332	DP16-0
5.2.5	Inductors				
L151	1	55µ H	30000-004	15933	

PARTS LIST

5.3 BIT DURATION SWITCH ASSEMBLY

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.
5.3.1		Resistors			
R2	1	3.3K, 1/2w,	10021-332	01121	EB3321
R11	1	1K, 2w 10% Var.	20053-102	01121	
R23	1	3.6K, 5%	10011-362	01121	EB3625
5.3.2		Capacitors			
C4	1	100 pf, 5%, S.M.	11017-101	00853	
C5	1	1.0 µf, 100v, Fxd. Paper	11124-105		
C6	1	0.1 µf, 100v, Fxd. Paper	11124-104	09023	
C7	1	0.01 µf, 300v, 1%, S.M.	11025-103	00853	
C8	1	1000 pf, 1%, S.M.	11027-102	00853	
C9	2	2.7 to 300 pf, 175v, Var. M.	11313-300	02799	461
C10	1	.68 pf, 5%, S.M.	11017-600	00853	
C11	1	27 pf, 5%, S.M.	11017-270	00853	
C12		Same as C9			
5.3.3		Switches			
S1	1	14 Pos, Shorting 3 Pole	25250-007	81716	

PARTS LIST

5.4 CIRCUIT BOARD ASSEMBLY - ATTENUATOR

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.
5.4.1		Resistors			
R127 thru R129	6	150 Ω, 2w, 5%	10013-151	01121	HB1515
R177 thru R179		Same as R127			
R201	4	200 Ω, 2w, 5%	10013-201	01121	HB2015
R202		Same as R201			
R203	4	47 Ω, 2w, 5%	10013-470	01121	HB4705
R204	4	47 Ω, 5%	10011-470	01121	EB4705
R205		Same as R204			
R206		Same as R203			
R207	4	15 Ω, 5%	10011-150	01121	EB1505
R208		Same as R207			
R211 and R212		Same as R201			
R213		Same as R203			
R214 and R215		Same as R204			
R216		Same as R203			
R217 and R218		Same as R207			
5.4.2		Capacitors			
C1	1	1000 µf, 15v	11150-108	56289	TVA1104

PARTS LIST

5.5 CIRCUIT BOARD ASSEMBLY, LEFT SIDE (NEGATIVE)

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.
5.5.1	Resistors				
R1	4	1K	10021-102	01121	EB1021
R13	3	470 Ω	10021-471	01121	EB4711
R14 and R15	2	3.3K	10021-332	01121	EB3321
R16		Same as R1			
R17	2	220 Ω	10021-221	01121	EB2211
R18	1	150 Ω, 5%	10011-151	01121	EB1515
R19	2	1.5K	10021-152	01121	EB1521
R20	2	6.8K	10021-682	01121	EB6821
R21		Same as R13			
R22	1	330 Ω	10021-331	01121	EB3311
R101	2	390 Ω, 5%	10011-391	01121	EB3915
R102	1	47K	10021-473	01121	EB4731
R103		Same as R101			
R104		Same as R1			
R105		Same as R19			
R106	1	2.2K	10021-222	01121	EB2221
R107		Same as R13			
R108		Same as R20			
R109	2	100 Ω	10021-101	01121	EB1011
R111	1	22 Ω	10021-220	01121	EB2201
R112		Same as R109			
R113		Same as R1			
R115 and R116	2	4.7K	10021-472	01121	EB4721
R117		Same as R17			
R118	1	10 Ω	10021-100	01121	EB1001
R119	1	680 Ω, 2w	10023-681	01121	HB6811
R120 thru R125	5	33 Ω, 5%	10011-330	01121	EB3305
5.5.2	Capacitors				
C3	3	100 pf, 5%, S.M.	11017-101	00853	
C13	1	27 pf, 5%, S.M.	11017-270	00853	
C14		Same as C3			
C15	1	0.1 µf, 75v, CER.	11242-104	91674	5815-000
C16	1	47 pf, 5%, S.M.	11017-470	00853	
C101		Same as C3			
C102 and C103	6	1 µf, 50v, Elect.	11152-105	MEC	
C105 thru C107		Same as C102			
C108	1	22 µf, 35v, Elect.	11512-226	56289	
C109	1	250 µf, 15v	11151-257	Siemens	B41283A
C160		Same as C102			

PARTS LIST

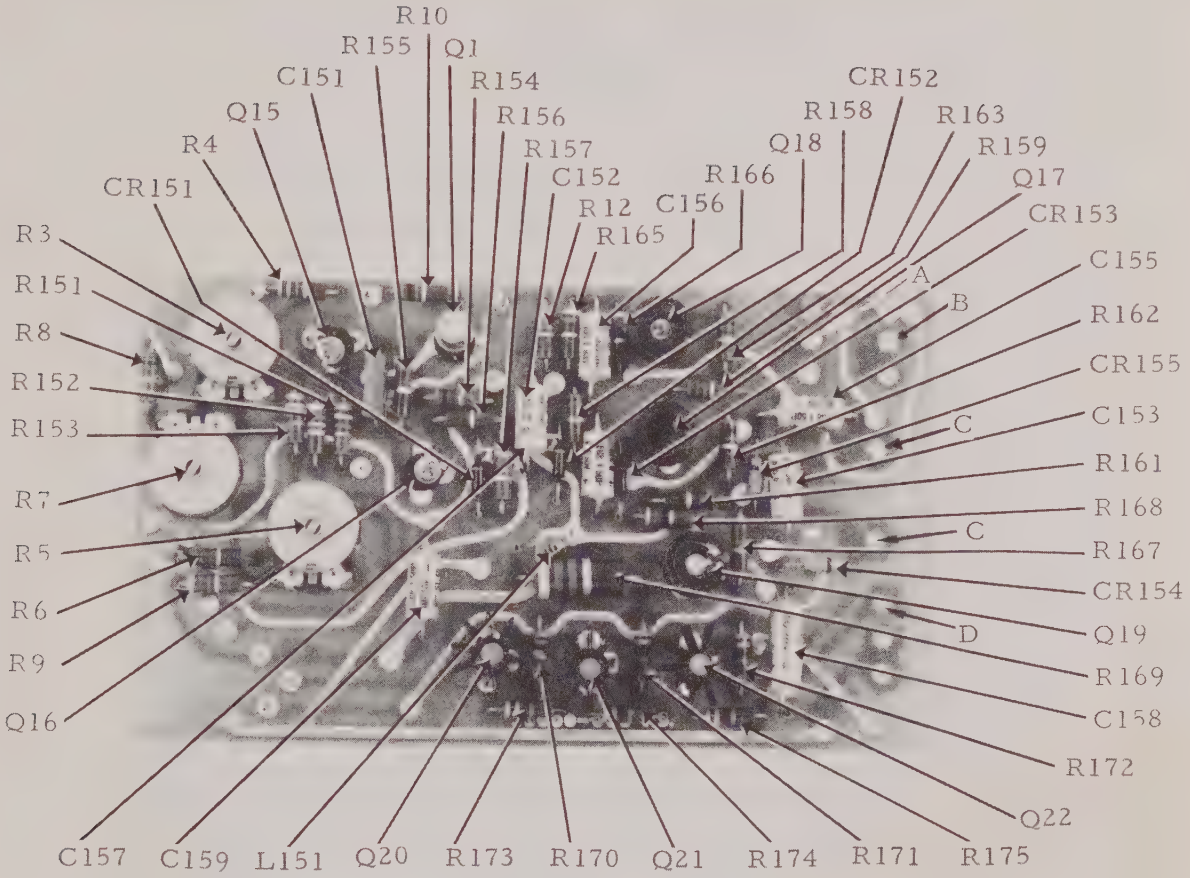
5.5 CIRCUIT BOARD ASSEMBLY, LEFT SIDE (NEGATIVE)

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.
5.5.3	Transistors				
Q2	1		22465-001	93332	DP46-1
Q3 thru Q5	3		22435-000		2N984
Q6	1		22465-000	15933	46-0
Q7 and Q8	4		22605-001	15933	60-1
Q9	1		22635-003	15933	63-3
Q10 and Q11		Same as Q7			
Q12 thru Q14	3		12685-004	94990	SM1330
5.5.4	Diodes				
CR1 thru CR4	9		22164-000	15933	DP16-0
CR101 thru CR105		Same as CR1			
5.5.5	Inductor				
L101	1	55μH	30000-004	15933	

PARTS LIST

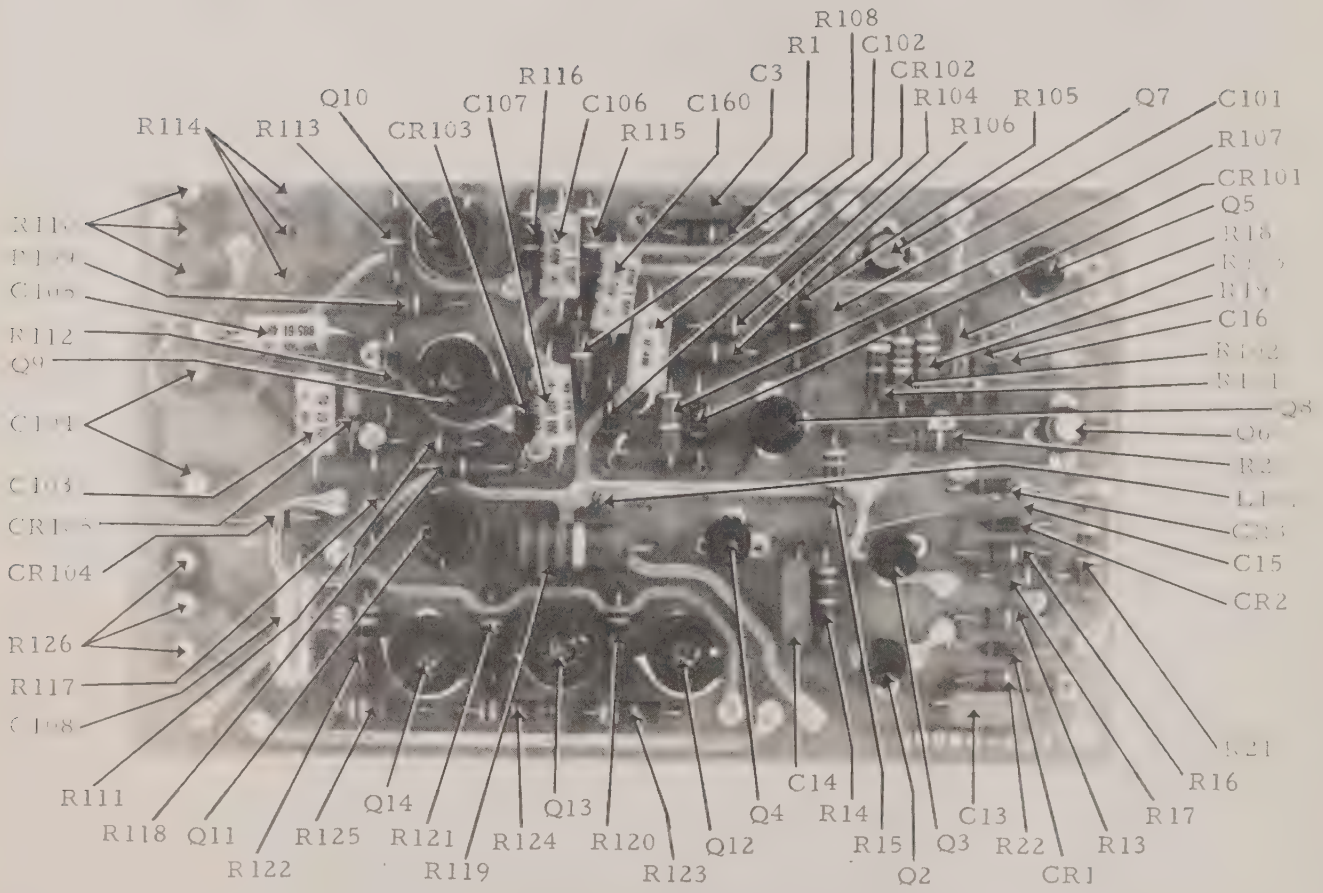
5.6 FINAL ASSEMBLY

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.
5.6.1		Resistors			
R110 thru R114	8	100 Ω x 2.5K, 2w, 20%, Var. Concentric	20123-101	01121	
R126	2	50 Ω, 2w, 10% Var.	20053-500	01121	
R160 thru R164		Same as R110			
R176		Same as R126			
5.6.2		Capacitors			
C104	2	10-365 pf, Var.	11292-321	Mitsumi	PVC-2K
C154		Same as C104			
5.6.3		Switches			
S101	2	DPDT Min.	15280-002	95146	
S102	2	SPDT Min.	15280-001	95146	
S151		Same as S101			
S152		Same as S102			



NOTE: R160, 164, 176 & C154 are mounted on front panel and are connected to holes on right side of circuit board. "A" set of holes for R164, "B" set of holes for R160, "C" set of holes for C154 and "D" set of holes for R176.

Figure 5-1. P901 Output Unit (right side).



NOTE: R110, 114, 126 and C104 are mounted on front panel and are connected to designated points on circuit board.

Figure 5-2. P901 Output Unit (left side).

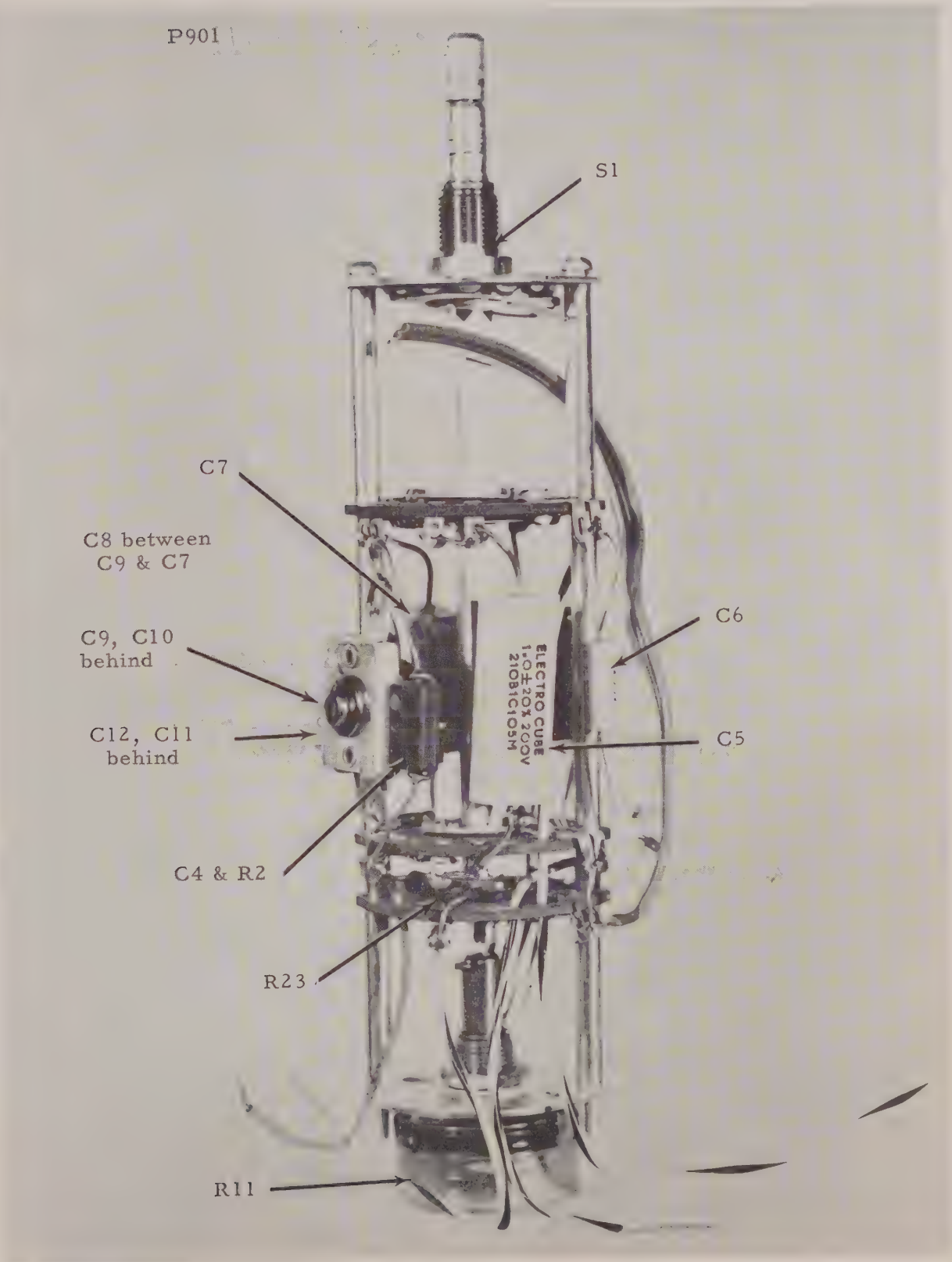
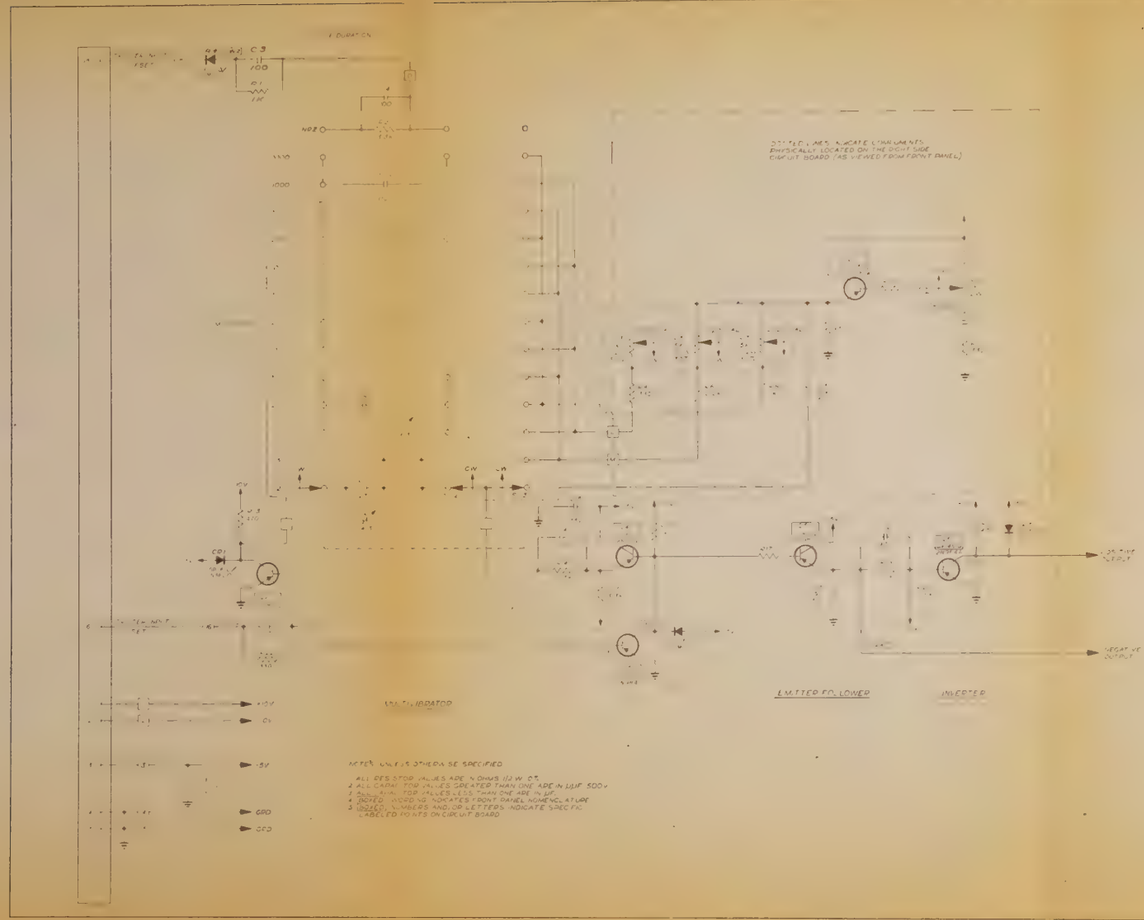


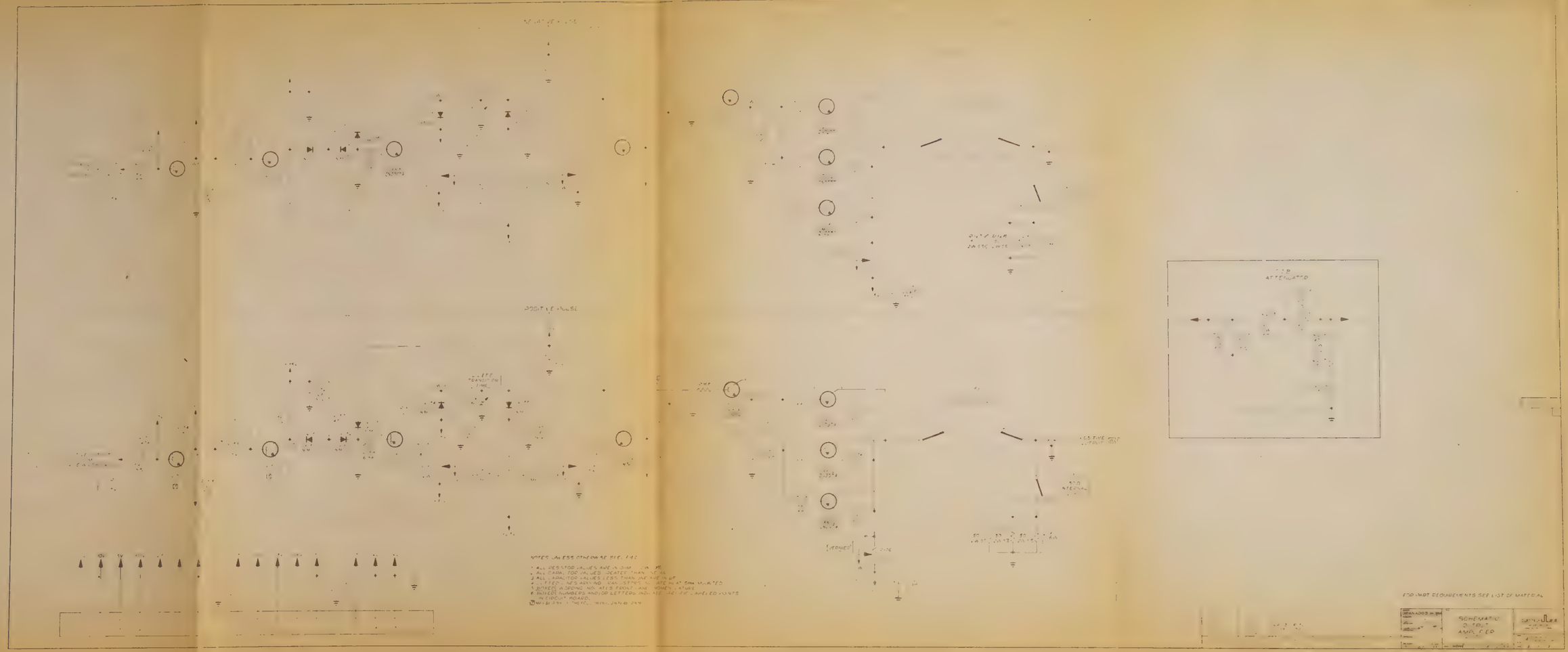
Figure 5-3. P901 Output Unit Pulse Duration Switch.

ADDENDA AND ERRATA

E. O. NO.	EFFECTIVE DATE	DWG. NO.	CHANGE
829	1-26-66	J40000-011B Sheet 2	Schematic - Output Amplifier. Lower left hand corner of schematic: 1. Across +18 and +23V. Add a 250µf, 15V, Fixed Elect. Capacitor. Positive to +23V. (Ref. Des. C150) 2. Across -18 and -23V. Add a 250µf, 15V, Fixed Elect. Capacitor. Negative to -23V. (Ref. Des. C109) 3. Change "Omitted" block from C109-C150 to C110-C149.
888	4-14-66	J40000-011B Sheet 2	Schematic - Pulse Width Circuitry Change Q6 from DP46-0, P/N 22465-000 to DP60-6, P/N 22605-006.
2049	7-6-66	J40000-011B Sheet 1	Schematic - Pulse Width Circuitry Change R12 from 330Ω, P/N 10021-331 to 270Ω, P/N 10021-271.
2102	9-14-66	J40000-011	Schematic 1. Change R159 from 100 , 1/2w, 10%, P/N 10021-101 to 150 , 1/2w, 10%, P/N 10021-151. 2. Change R168 from 47 , 1/2w, P/N 10021-470 to 22 , 1/2w, 10%.
2021	8-26-66	Transistor Equiv.	SM 1330, P/M 12685-004 is an acceptable substitute for DP63-6, P/N 22635-006.
2081	8-26-66	Transistor Substitution	2N2102, P/N 12685-005 may be used in lieu of 2N2270, P/N 12695-001.
2099	9-13-66		Change calibration procedure from -5 volts to -6 volts.
2367	11-13-67	SB 1-65	Transistor 2N2369A P/N 22635-003 is an acceptable substitute for DP63-4 P/N 22635-004.


+15V
0V
-15V
GRD
OCD
NEGATIVE OUTPUT
EMITTER FOLLOWER
INVERTER
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS 1/2 W. CT.
2. ALL CAPACITOR VALUES GREATER THAN ONE ARE IN MMF 500 V
3. ALL CAPACITOR VALUES LESS THAN ONE ARE IN MF.
4. BOXED - USED TO INDICATES FRONT PANEL NOMENCLATURE
5. CIRCLED NUMBERS AND OR LETTERS INDICATE SPECIFIC LABELED POINTS ON CIRCUIT BOARD

FOR PART REQUIREMENTS SEE LIST OF MATERIAL


POSITIVE PULSE
NEGATIVE PULSE
NOTES: UNLESS OTHERWISE SPECIFIED
FOR MOUNTING REQUIREMENTS SEE LIST OF MATERIAL

SEMICONDUCTOR REPLACEMENTS

(Applicable to all Datapulse Models except the Model 102.)

Datapulse makes extensive use of house labeled semiconductors, superseding or used in place of commercial equivalents. In most cases, these are procured against relaxed or actual commercial equivalent specifications, and commercial equivalents as listed below may, therefore, be used as replacements.

DATAPULSE TYPE NO.	DATAPULSE PART NO.	COMMERCIAL EQUIVALENT
Diodes:		
DP16-0	22164-000	1N3600
DP16-1	22164-001	1N3604
DP16-2	22164-002	HPA1003
DP19-0	22194-000	1N2070
DP19-1	22194-001	1N4002
DP19-6	22194-006	1N2071
Transistors:		
DP43-0	22435-000	2N984
DP46-0	22465-000	2N964A
DP46-1	22465-001	None*
DP59-0	22595-000	2N1132A
DP60-0	22605-000	2N2411
DP60-1	22605-001	None*
DP60-2	22605-002	2N2904 or 2N3133
DP60-3	22605-003	2N2894
DP60-4	22605-004	2N3209
DP60-5	22605-005	ft1702
DP60-6	22605-006	2N3640
DP60-7	12605-007	None*
DP63-0	22635-000	2N2369 or 2N2501
DP63-1	22635-001	2N3723
DP63-2	22635-002	None*
DP63-3	22635-003	2N2369A (Fairchild)
DP63-4	22635-004	2N3646 or MPS3646 or 2N2369A
DP63-6	22635-006	2N2270

*Replacements for the following items should be procured from Datapulse:

DP46-1 is selected from 2N2964A for high Beta.
DP60-1 is selected from 2N2894 for high V ceo.
DP63-2 is selected from 2N914 for tighter Beta tolerance.
DP60-7 is selected from DP60-1 for 25 volt breakdown.

1-10-68

WARRANTY

Datapulse Incorporated warrants each instrument of its manufacture to be free from defects in material and workmanship. Our obligation under this Warranty is limited to servicing or adjusting any instrument returned to our factory for that purpose, and to making good at our factory any part or parts thereof except tubes, transistors, fuses or batteries which shall, within one year after making delivery to the original purchaser, be returned to us with transportation charges prepaid, and which our examination shall disclose to our satisfaction to have been thus defective.

Instruments returned under this Warranty will not be accepted at the Datapulse plant without prior authorization by a Datapulse representative or by the service manager of Datapulse Incorporated.

Datapulse Incorporated reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This Warranty is expressly in lieu of all other obligations or liabilities on the part of Datapulse Incorporated and Datapulse Incorporated neither assumes nor authorizes any other person to assume for them any other liability in connection with the sales of Datapulse Incorporated instruments.

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